

# Wireless Network Design Considerations

## 1.0 Overview

### 1.1 Introduction

- In a wireless network design, there are several factors to consider. This document is broken into sections to provide a series of questions for fact finding to better address wireless design concerns. The questions listed were primarily referenced in Gartner Research paper G00171433 *Toolkit: Technology Section of a WLAN RFP* and supplemented by staff at the WNYRIC of Erie 1 BOCES.

### 1.2 Document intention

- The intent of this document is to provide an overall questionnaire;
  - To aide a proper wireless network design,
  - To elicit district input to design decisions,
  - To document the decisions the district chose,
  - And to provide a default answer in absence of district input.
- It is important to understand this document is intended to solicit input and design criteria to determine a proper solution based on the district requirements. It is not intended to conflict with past recommendations as those were developed with older technology and different design decisions.
- This is intended to be a “living” document, evolving with changing district requirements and technology advancements.

## 2.0 The End-User Experience

### 2.1 User counts and type determination

- Who are the wireless users and what uses/applications will they need from the wireless network?
  - I.e. Students, Teachers, Office Staff, Guests, Contractors, Vendors, Facility, Support Staff, etc.
  - I.e. Internet, videoconference, VoWLAN, assessment testing, file transfers, etc.
- Are there wireless units such as printers, control systems, cameras that will use the wireless network?
- What is the best estimate for growth in the next few years for both users and capacity?
- **Default design without specific input**
  - ***Plan that all students and staff will use the wireless network.***
  - ***Plan that visitors and guests will use the wireless network.***
  - ***Plan for 2 devices per 1 user ratio.***

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## 2.2 Per-User Capacity Planning

- What are the current and potential applications and usage scenarios?
- What WLAN requirements are associated with each application?
- What is the peak, average, concurrent capacity or throughput is needed by each type of user, in each application scenario?
- Is QoS needed?
- **Default design without specific input**
  - **Plan on 5 Mbps per user concurrently.**
    - ***This means using 802.11n as 802.11g practically supports 5 devices per AP at 5 Mbps.***
  - ***Many WLANs have been designed for "connection" and not for "capability." Designed for connection means that clients are able to connect to the wireless infrastructure, and, although the access point can transmit up to 54 Mbps in an 802.11g environment, the user may experience only 1 Mbps of raw throughput.***

## 2.3 Coverage Areas and Density

- Are there building diagrams? Are they dimensioned properly?
  - Are there CAD/building material drawings that can be imported into a design-planning tool?
  - Lacking the CAD drawings, are their other building diagrams available in JPEG format for hand drawings?
  - Are the wiring closet locations and cable locations known, documented, and marked appropriately on diagram?
- Where will the wireless network be used?
- How many users/devices will be using the wireless network in what locations?
- Is the district willing to invest in a predesign wireless site survey to determine current coverage and availability?
- Will the district invest in a wireless site survey on an annual basis?
- **Default design without specific input**
  - ***Plan 1 AP per classroom and an office area with potential of 30 users per AP.***
  - ***Plan to support 100 or more client devices in large areas such as auditorium, cafeteria, gymnasium, and athletic fields.***
  - ***A post installation wireless site survey will be performed to audit and remediate installation.***
  - ***Schedule annual site survey at time of project completion***
  - ***DO NOT use mobile AP's such as AP on a mobile cart. It causes interference and changes the wireless environment.***
  - ***Purchase 5% spare AP's units for design supplement and testing.***

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## 2.4 Transaction Density

- **Default design**
  - *Transaction density will be determined by the client density and user/application capacity needs.*

## 2.5 Definition of Types of Clients

- What types of client devices will be using the wireless network? What type of radios, antennae and transmit power are available in the clients?
  - I.e. laptops, desktops, tablets, smartphones, VoWLAN handsets, wireless network printers and scanners, security cameras, Wi-Fi active RFID tags.
- What devices will be configured for 802.11b/g, 802.11a, and/or 802.11n in what frequency ranges of 2.4 Ghz and 5.0 Ghz?
- **Default design without specific input**
  - *Plan for iPads, which have a single radio with the weakest transmit power of most devices.*
  - *Move all available devices to 5.0 Ghz 802.11n and/or 802.11a.*
  - *Eliminate 802.11b systems.*
  - *Minimize 802.11g systems, and 2.4 Ghz 802.11n if they can't be eliminated.*
  - *Ensure client drivers and software are regularly scheduled and updated to latest approved releases.*

## 3.0 Environmental and Operating Conditions

### 3.1 Site Survey and Monitoring

- What is the environmental noise floor for the areas where the WLAN will be installed for 2.4GHz and 5GHz?
- What is the signal-to-noise ratio policy for the district?
- Do any areas require special antennas?
- Has a spectrum analysis been done as part of a wireless site survey?
- What will be the ongoing plan for non-WiFi interference monitoring?
- **Default design without specific input**
  - *Use a signal-to-noise ratio of 25 dB*
  - *Without a specific survey, design 1 AP per room*
    - *Optionally, use Ekahau planning tool for design*
  - *Provide a means to perform spectrum analysis and interference monitoring both pre and post installation.*
    - *Use AP's with built in function or use on-site probes*

### 3.2 Linking the WLAN Components to the Wired Infrastructure

- Is there proper wiring to connect the proposed AP locations?
  - Will the wire support gigabit Ethernet?
- Are there enough switched based PoE ports available with enough power to power all the devices?

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- Can the district provide clean and consistent power to the AP's and PoE switches?
- Is there a need for dual wires to each AP to ensure future growth?
- Is there a plan or process to put in new cabling if needed (capital project)?
- Will the AP's be powered by PoE, PoE Plus (802.3at) or some other method?
- Are there other devices that require PoE as well, such as security cameras?
- Is there a proper count and wiring design to show how many powered devices will be in each wiring closet?
- Is there a need for wired areas that are high density and demand such as AutoCAD labs?
- **Default design without specific input**
  - **Add enough switches to the project to provide minimally 24 ports PoE+ to each wiring closet.**
  - **Recommend dedicated 2 wiring drops to each AP.**
    - **Do not repurpose a desktop drop unless it is relocated.**
    - **Wiring drop must have female end to allow for 15' service loop (patch cable).**
  - **Without cabling plan the only option would be to identify if there is an existing drop to the locations that can be used.**
  - **Allow for multiple ports in core of network with a minimum 4 port Link Aggregation Group (LAG) between the wireless controller and network switches.**
  - **Assume the district has good and consistent power for AP's and PoE switches.**

## 3.3 High availability

- What level of reliability should the infrastructure be designed to accommodate?
- Is overlapping coverage of adjacent access points required?
- Is redundancy in the controller required?
- If there is a problem with the Ethernet cabling, is a wireless mesh, which allows the access points to communicate to each other required?
- Are multi-homed access points required (i.e., be able to have primary and second wired connections to different upstream switches)?
- **Default design without specific input**
  - **Provide high availability controllers and power supplies**
  - **Provide multi-homed AP's as permitted by cabling**

## 3.4 Maintenance and Repair

- What does the district desire for maintenance options?
  - Does the district want a same day or next business day replacement contract, or will the district carry spare components?
  - Does the district have a maintenance plan to keep all wireless network equipment and management components up to date for software?

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- Will the district replace equipment at the end of life dates or continue to use unsupported?
- **Default design without specific input**
  - *Provide same day replacement on controllers*
  - *Provide licensing of software updates on all components*
  - *Do not purchase maintenance on AP's.*
    - *Communicate to the district whether or not the AP's have lifetime replacements.*

## 3.5 Network Management

- Does the district want to manage the wireless network or does the district wish to contract the management?
- Is there a need for multivendor support?
  - Please identify all supported vendors.
- Does the wireless network management application need to integrate with the wired enterprise management strategy?
- What is the district policy for rogue AP enforcement?
- Does the district have a policy for working with AP's from the neighborhood and how it interferes with the wireless network?
- How does the district want to identify and replace failed components and implemented redundancies?
  - Who should get alerts and provide diagnostics?
- Does the district want to enable auto-tuning of the AP's or should that function be provided manually?
- Does the district want historical trend and network usage reporting?
- Does the district desire a post site survey to audit/remediate the design?
- **Default design without specific input**
  - *The RIC will manage the system and perform all repairs.*
  - *Build a network management system for the district, import diagrams as available, generate heat maps as capable, and input building materials on the maps as possible.*
  - *Rogue AP's will be identified and manually removed if on district property.*
  - *Alerts will go to RIC and appropriate district personnel.*
  - *The system will be set to 'auto tune.'*
  - *A post site survey will be performed and provided to the district.*
  - *Schedule annual site surveys as part of the project.*

## 3.6 Migration Strategy for Existing Mixed Networks

- Are there legacy access points that will remain in service?
  - Is there a desire to keep legacy system in different building?
- Will the new solution manage the legacy AP's?
  - Is it acceptable to have multiple management systems if needed?
- **Default design without specific input**

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- *Replace all the existing AP's and controllers to allow for a single system*

## 4.0 Network Services

### 4.1 Security and Authentication

- Will the client devices support WPA2-AES?
  - Are there clients that do not support WPA2-AES?
- Will the Extensible Authentication Protocol (802.1x) be used?
  - Is the server infrastructure available to support EAP?
  - Does the recommended solution have an integrated RADIUS option, or is an external server required?
  - Are there any limitations associated with the supplicants that can be used?
- Does the district have a policy in place to address BYOD and Guest access?
  - Is there a VLAN structure that will support segregation by firewall and routing segmentation for BYOD, Guest, Internal devices?
- Is a captive portal guest access solution needed?
  - Does the district require device registration for guest or BYOD access?
- Is NAC and device interrogation/remediation desired (OS and patch levels)?
- Is there a desire for rogue device/AP detection and remediation?
- Will the district get rid of pre-shared keys?
- **Default design without specific input**
  - **Use WPA2-AES**
  - **Use 802.1x**
  - **Use Authentication system (i.e. Identity Engines, ISE, Bradford, ClearPass)**
    - **Identify the device by MAC Address**
    - **Identify the user by district directory**
    - **Based on the following query do the following**

Device	User	VLAN
<u>Managed</u>	<u>Known</u>	<u>Internal</u>
<u>Managed</u>	<u>Not</u>	<u>Remediation</u>
<u>Not</u>	<u>Known</u>	<u>BYOD</u>
<u>Not</u>	<u>Not</u>	<u>Guest</u>

- **Set Guest VLAN to restrictive policy without tracking user**

### 4.2 Advanced Network Protocols

- Is support Wi-Fi Multimedia for quality of service (QoS) needed?
- Is support of VoIP wireless handsets needed?
- Is support for multicast frames needed?
- **Default design without specific input**
  - **Enable WiFi Multimedia (WMM) for Voice QoS**
  - **Enable Call Admission Control (CAC)**

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## 4.3 Location-Based Services

- Are location-based services required?
- What is the documented proximity to the asset that is needed?
- ***Default design without specific input***
  - ***Include location services, with accuracy within 5 meters***
    - ***Location is a factor of AP density and diagram accuracy***

Final Draft

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## References

Zimmerman, T. King, M. (2009, November 11). *Toolkit: Technology Section of a WLAN RFP*. Gartner G00171433

Dziuba, M. Holbrook, J. (2012, September 19). *Discussion input from Sr. LAN/WAN meeting*. Recorded at Erie 1 BOCES/WNYRIC on September 19, 2012 and October 3, 2012.

Final Draft